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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
218877US2PCT

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
10/049613

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/07000	**06 October 2000**	**21 June 2000**

TITLE OF INVENTION
DATA TRANSMISSION SYSTEM

APPLICANT(S) FOR DO/EO/US
KATAYAMA Masatoshi

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

PCT/IB/304
PCT/IB/308
Form PTO-1449 / Request for Priority
Drawings (6 sheets) / Cited References (2)

JC10 Rec'd PCT/PTO 21 FEB 2002

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/049613	PCT?JP00/07000	218877US2PCT

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	x $18.00	**$0.00**	
Independent claims	4 - 3 =	1	x $84.00	**$84.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$974.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				**$0.00**	
SUBTOTAL =				**$974.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$974.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$974.00**	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **974.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. ______ in the amount of ______ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Surinder Sachar
Registration No. 34,423

22850

Surinder Sachar
SIGNATURE

Marvin J. Spivak
NAME

24,913
REGISTRATION NUMBER

Feb. 21 2002
DATE

10/049613

6/PRTS

JC10 Rec'd PCT/PTO 21 FEB 2002

SPECIFICATION

TITLE OF THE INVENTION

DATA TRANSMISSION SYSTEM

TECHNICAL FIELD

The present invention relates to a data transmission system comprising subscriber units connected to a central office unit via optical fibers, in which the central office unit multiplexes a video signal with signals other than the video signal and delivers them to the multiple subscriber units, and the subscriber units each demultiplex their own received signals.

BACKGROUND ART

Fig. 1 is a block diagram showing a configuration of an ATM-PDS (Asynchronous Transfer Mode Passive Double Star) system as a conventional data transmission system. In Fig. 1, the reference numeral 101 designates a central office unit comprising multiple transmitting and receiving sections, although only one transmitting and receiving section 114 is shown for simplicity. The reference numeral 102 designates a star coupler as an optical distributor that is connected to the central office unit 101 via an optical fiber 103; 104a-104c each designate an optical fiber connected to one of split output terminals of the star coupler 102; and 105a-105c each designate a subscriber unit connected to one of the optical fibers 104a-104c. Since the split number of a single star coupler is 32 at present, the total of 32 subscriber units can be connected to each star coupler by connecting them to the split output

terminals via the optical fibers 104a-104c....

The central office unit 101 comprises a transmitting laser diode (LD) 112 for outputting a video signal generated by a video signal generator 111 in the form of an optical signal; a wavelength division multiplexer/demultiplexer (WDM) 113 supplied with the output of the transmitting laser diode (LD) 112 and the output of the transmitting and receiving section 114; an electric signal multiplexer/demultiplexer 115; and a processing section 116. The transmitting and receiving section 114 includes a wavelength division multiplexer/demultiplexer (WDM) 121; a receiving photodiode (PD) 123 for converting an optical signal supplied from the wavelength division multiplexer/demultiplexer (WDM) 121 into an electric signal; a transmitting laser diode (LD) 122 for converting an electric signal to an optical signal; and a signal processor 124. The processing section 116 includes a signal processor 117, a transmitting laser diode (LD) 118 and a receiving photodiode (PD) 119.

The subscriber unit 105a comprises a wavelength division multiplexer/demultiplexer (WDM) 131a connected to the fiber 104a; a receiving photodiode (PD) 132a for receiving a wavelength band of a video signal separated by the wavelength division multiplexer/demultiplexer (WDM) 131a and for outputting it as an electric signal; a video receiver 133a supplied with the electric signal; and a transmitting and receiving section 134a supplied with signals other than the video signal separated by the wavelength division multiplexer/demultiplexer (WDM) 131a. The transmitting and receiving section 134a includes a wavelength division multiplexer/demultiplexer (WDM) 141a; a receiving photodiode (PD) 142a for converting an optical signal

fed from the wavelength division multiplexer/demultiplexer (WDM) 141a into an electric signal; a transmitting laser diode (LD) 143a for converting an electric signal into an optical signal; an electric signal multiplexer/demultiplexer 144a; an A/D (Analog/Digital) converter 145a to which a telephone 147a is connected; and an A/D (Analog/Digital) converter 146a to which a facsimile machine 148a is connected. A personal computer 149a is directly connected to the electric signal multiplexer/demultiplexer 144a. The subscriber unit 105b connected to the optical fiber 104b has a similar configuration. When no video receiver is required as in the subscriber unit 105b, a terminator 135b is connected in place of the receiving photodiode (PD).

Next, the operation will be described.

In the central office unit 101, the video signal generator 111 supplies its video signal to the transmitting laser diode (LD) 112. The transmitting laser diode (LD) 112 supplies it to the wavelength division multiplexer/demultiplexer (WDM) 113 in the form of the optical signal. The wavelength division multiplexer/demultiplexer (WDM) 113 multiplexes the optical signal with the optical signal from the transmitting and receiving section 114, and supplies it to the star coupler 102 via the optical fiber 103. The star coupler 102 splits the signal and supplies the split signals to the subscriber units 105a, 105b and the like.

In the subscriber unit 105a, the wavelength division multiplexer/demultiplexer (WDM) 131a demultiplexes the input signal into the video signal and the other signals, and supplies the video signal to the video receiver 133a via the receiving photodiode (PD) 132a. On the other hand, the signals other than

the video signal are supplied to the receiving photodiode (PD) 142a via the wavelength division multiplexer/demultiplexer (WDM) 141a in the transmitting and receiving section 134a, to be converted into the electric signal. Then, the electric signal multiplexer/demultiplexer 144a demultiplexes the electric signal into respective signals so that the telephone signal is supplied to the telephone set 147a via the A/D converter 145a, and the facsimile signal is supplied to the facsimile machine 148a via the A/D converter 146a. As for the computer signal, the electric signal multiplexer/demultiplexer 144a supplies it directly to the personal computer 149a.

On the other hand, as for the signals from the devices connected to the subscriber unit 105a such as the signal from the telephone set 147a, for example, the A/D converter 145a converts it to the digital signal, and supplies it to the transmitting laser diode (LD) 143a via the electric signal multiplexer/demultiplexer 144a. The transmitting laser diode (LD) 143a converts it to the optical signal, and supplies it to the star coupler 102 via the wavelength division multiplexer/demultiplexers (WDMs) 141a and 131a. The star coupler 102 sends it to the central office unit 101 via the optical fiber 103, where it is supplied to the receiving photodiode (PD) 123 via the wavelength division multiplexer/demultiplexers (WDMs) 113 and 121, to be converted into the electric signal and output. The output signal passes through the signal processor 124 and the electric signal multiplexer/demultiplexer 115, and is supplied to the processing section 116, where it passes through the signal processor 117, and is converted to the optical signal by the transmitting laser diode (LD) 118, again, to be transmitted to another station.

In the foregoing conventional data transmission system, it is considered preferable to divide the wavelength range 1480-1580 nm, which is assigned to the downlink signals from the central office unit to the subscriber units, into two regions of 1480-1530 nm and 1530-1580 nm, and to assign the longer wavelength region 1530-1580 nm to video signal deliverance. In this case, the subscriber unit requires the wavelength division multiplexer/demultiplexer (WDM) that demultiplexes the wavelength region 1480-1580nm assigned to the downlink signal into the wavelength region 1530-1580 nm for the video signal and to the wavelength range 1480-1530 nm assigned to the signals other than the video signal.

As a typical conventionally used wavelength division multiplexer/demultiplexer (WDM), a spatial optical filter is known. Fig. 2 shows a spatial optical filter. It comprises a glass substrate 151, on a side of which a reflecting layer 152 is formed that reflects a particular wavelength signal. It further comprises, at both sides of the glass substrate 151, condenser lenses 153 and 154 which are coupled with the optical fibers 155 and 156, respectively, and a condenser lens 157 coupled with an optical fiber 158 in such a manner that the reflected light off the reflecting layer 152 is launched into the optical fiber 158 through the condenser lenses 157.

As described above, the spatial optical filter has a complicated configuration. In particular, it is difficult to align the optical axes of the optical fiber and of the condenser lenses, increasing the total cost. Since the expensive spatial optical filter is installed in the subscriber unit to separate the video signal and the signals other than the video signal, the subscriber unit is costly. This offers a problem in that

a subscriber who does not want to receive the video service must purchase the expensive subscriber unit.

The present invention is implemented to solve the foregoing problem of the conventional system. Therefore, an object of the present invention is to provide an inexpensive subscriber unit for a subscriber who does not want to receive the video service.

DISCLOSURE OF THE INVENTION

According to a first aspect of the present invention, there is provided a data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, the data transmission system comprising in the subscriber unit: a wavelength division multiplexer/demultiplexer (WDM) having a function of eliminating a particular wavelength signal.

It relieves a subscriber who does not want to receive the video service of the requirement of the expensive spatial optical filter for separating the video signal and the other signals. Thus, it offers an advantage of being able to provide the subscriber with the inexpensive subscriber unit capable of transmitting data other than the video signal without using the expensive spatial optical filter.

The wavelength division multiplexer/demultiplexer (WDM) of the data transmission system according to the present invention can reflect the particular wavelength signal to reject its input. Thus, it offers an advantage of being able to provide

an inexpensive wavelength division multiplexer/demultiplexer (WDM) with a simple configuration.

The wavelength division multiplexer/demultiplexer (WDM) of the data transmission system according to the present invention can comprise a reflecting layer for reflecting the particular wavelength signal at an input end surface of an optical fiber of the subscriber unit. Thus, it offers an advantage of being able to provide an inexpensive wavelength division multiplexer/demultiplexer (WDM) with a simple configuration.

The reflecting layer of the wavelength division multiplexer/demultiplexer (WDM) of the data transmission system according to the present invention can consist of a dielectric multilayer filter. Therefore, it offers an advantage of being able to provide an inexpensive wavelength division multiplexer/demultiplexer (WDM) with a simple configuration.

The data transmission system according to the present invention can comprise an optical fiber with a core and a cladding that covers an external surface of the core, and that has multiple notches formed on the cladding to reflect the particular wavelength signal. Thus, it can increase the flexibility of the video signal to be separated.

The data transmission system according to the present invention can use an optical waveguide that is made of a polymer and absorbs a signal with a wavelength of 1650 nm as the wavelength division multiplexer/demultiplexer, and uses the signal with a wavelength of 1650 nm as the particular wavelength signal. It offers an advantage of being able to implement an inexpensive wavelength division multiplexer/demultiplexer (WDM) capable of absorbing the signal with a wavelength of 1650

nm.

According to a second aspect of the present invention, there is provided a data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, the central office unit comprising: an optical amplifier for amplifying the video signal to be transmitted; and an optical distributor for distributing the video signal output from the optical amplifier, and supplying it to a wavelength division multiplexer/demultiplexer, wherein each of the subscriber units comprises a wavelength division multiplexer/demultiplexer having a function of eliminating a particular wavelength signal.

Thus, it offers an advantage of being able to share the video signal generator, thereby reducing its cost.

According to a third aspect of the present invention, there is provided a data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, the central office unit comprising: a plurality of video signal generators for generating video signals with different wavelengths; a first wavelength division multiplexer/demultiplexer for multiplexing the video signals supplied from the plurality of video signal generators; an optical amplifier for amplifying the video signals output from the first wavelength division

multiplexer/demultiplexer; and an optical distributor for distributing the video signals output from the optical amplifier to a second wavelength division multiplexer/demultiplexer, wherein each of the subscriber units comprises a wavelength division multiplexer/demultiplexer with a function of eliminating a particular wavelength signal.

Thus, it offers an advantage of being able to cope with an expected growing capacity in the near future easily.

According to a fourth aspect of the present invention, there is provided a data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, the subscriber unit comprising: a first wavelength division multiplexer/demultiplexer for demultiplexing the video signals and signals other than the video signal; and a second wavelength division multiplexer/demultiplexer with a function of eliminating a particular wavelength signal.

Thus, it enables the second wavelength division multiplexer/demultiplexer to remove the remainder of the video signal the first wavelength division multiplexer/demultiplexer cannot fully separate. Therefore it can utilize an inexpensive WDM with comparatively low separation accuracy as the first wavelength multiplexer.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a configuration of a conventional data transmission system;

Fig. 2 is a schematic diagram showing a configuration of a spatial optical filter as a wavelength division multiplexer/demultiplexer used by the conventional data transmission system;

Fig. 3 is a block diagram showing a configuration of an embodiment 1 of the data transmission system in accordance with the present invention;

Fig. 4 is a schematic diagram showing a configuration of a wavelength division multiplexer/demultiplexer (WDM) used by the data transmission system in accordance with the present invention;

Fig. 5 is a graph illustrating the attenuation at the wavelength in the optical waveguide section of the wavelength division multiplexer/demultiplexer (WDM);

Fig. 6 is a schematic diagram showing other configurations of a wavelength division multiplexer/demultiplexer (WDM) used by the data transmission system in accordance with the present invention;

Fig. 7 is a block diagram showing a configuration of an embodiment 2 of the data transmission system in accordance with the present invention; and

Fig. 8 is a block diagram showing a configuration of an embodiment 3 of the data transmission system in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The best mode for carrying out the invention will now be described with reference to the accompanying drawings.

EMBODIMENT 1

Fig. 3 is a block diagram showing a configuration of an

embodiment 1 of the data transmission system in accordance with the present invention. In Fig. 3, the reference numeral 1 designates a central office unit comprising multiple transmitting and receiving sections, although only one transmitting and receiving section 14 is shown for simplicity of the description. The reference numeral 2 designates a star coupler (SC) as an optical distributor that is connected to the central office unit 1 via an optical fiber 3; 4a-4c each designate an optical fiber connected to one of split output terminals of the star coupler 2; and 5a and 5b each designate a subscriber unit connected to one of the optical fibers 4a and 4c. Since the split number of a single star coupler is 32 at present, the total of 32 subscriber units can be connected to each star coupler by connecting them to the split output terminals via the optical fibers 4a-4c....

The central office unit 1 comprises a transmitting laser diode (LD) 12 for outputting a video signal generated by a video signal generator 11 in the form of an optical signal; a wavelength division multiplexer/demultiplexer (WDM) 13 supplied with the output of the transmitting laser diode (LD) 12 and the output of the transmitting and receiving section 14; an electric signal multiplexer/demultiplexer 15; and a processing section 16. The transmitting and receiving section 14 includes a wavelength division multiplexer/demultiplexer (WDM) 21; a receiving photodiode (PD) 23 for converting an optical signal fed from the wavelength division multiplexer/demultiplexer (WDM) 21 into an electric signal; a transmitting laser diode (LD) 22 for converting an electric signal to an optical signal; and a signal processor 24. The processing section 16 includes a signal processor 17, a transmitting laser diode (LD) 18 and a receiving

photodiode (PD) 19.

The subscriber unit 5a comprises a wavelength division multiplexer/demultiplexer (WDM) 31a connected to the optical fiber 4a; a receiving photodiode (PD) 32a for receiving a wavelength band of a video signal separated by the wavelength division multiplexer/demultiplexer (WDM) 31a and for outputting it as an electric signal; a video receiver 33a supplied with the electric signal; and a transmitting and receiving section 34a supplied with signals other than the video signal separated by the wavelength division multiplexer/demultiplexer (WDM) 31a. The transmitting and receiving section 34a includes a wavelength division multiplexer/demultiplexer (WDM) 41a; a receiving photodiode (PD) 42a for converting an optical signal from the wavelength division multiplexer/demultiplexer (WDM) 41a into an electric signal; a transmitting laser diode (LD) 43a for converting an electric signal into an optical signal; an electric signal multiplexer/demultiplexer 44a; an A/D (Analog/Digital) converter 45a to which a telephone 47a is connected; and an A/D (Analog/Digital) converter 46a to which a facsimile machine 48a is connected. A personal computer 49a is directly connected to the electric signal multiplexer/demultiplexer 44a.

The wavelength division multiplexer/demultiplexer (WDM) 41a rejects the wavelength region of the video signal consisting of a 1530-1580 nm signal, for example. Since the subscriber unit 5b connected to the optical fiber 4b and the like has a configuration similar to the subscriber unit 5a, the description thereof is omitted here.

Fig. 4 is a schematic diagram illustrating an example of the wavelength division multiplexer/demultiplexer (WDM) 41a (41b or the like). In Fig. 4, the reference numeral 61 designates

a waveguide chip; 62 designates a transmitting laser diode (LD) disposed on a first end surface 61a side of the waveguide chip 61 to emit light with a 1300 nm wavelength region; 63 designates an optical fiber disposed on the first end surface 61a side of the waveguide chip 61 to receive external light with a 1500 nm wavelength region; 64 designates a wavelength division multiplexer/demultiplexer (WDM) disposed on a second end surface 61b of the waveguide chip 61; and 65 designates a receiving photodiode (PD) disposed on the second end surface 61b side of the waveguide chip 61.

In the waveguide chip 61, the reference numeral 66 designates a first optical waveguide for propagating the light with the 1300 nm wavelength region emitted from the transmitting laser diode (LD)62; 67 designates a second optical waveguide for propagating the light with the 1500 nm wavelength region supplied via the optical fiber 63, and the light with the 1300 nm wavelength region passing through the first optical waveguide 66 and reflecting off the wavelength division multiplexer/demultiplexer (WDM) 64; and 68 designates a junction of the first optical waveguide 66 and the second optical waveguide 67 formed by connecting the WDM filter side end of the first optical waveguide 66 with the WDM filter side end of the second optical waveguide 67.

The receiving photodiode (PD) 65 is placed normally to the second optical waveguide 67 with respect to the wavelength division multiplexer/demultiplexer (WDM) 64, and closely to the junction 68 of the first optical waveguide 66 and the second optical waveguide 67. The junction 68 of the first optical waveguide 66 and the second optical waveguide 67 constitutes an emitting position of the light with the 1500 nm wavelength

region that propagates the second optical waveguide 67 and is output from the optical waveguide 61.

The light with the 1300 nm wavelength region emitted from the transmitting laser diode (LD) 62 reflects off the wavelength division multiplexer/demultiplexer (WDM) 64, and is supplied to the optical fiber 63 to be output. On the other hand, the light with the 1500 nm wavelength region input through the optical fiber 63 passes through the wavelength division multiplexer/demultiplexer (WDM) 64, and is supplied to the receiving photodiode (PD) 65.

Using a polymer such as polyimide for the second optical waveguide 67 can offer the characteristics as illustrated in Fig. 5, in which a 1650 nm wavelength region is sharply attenuated. Accordingly, setting the wavelength of the video signal near 1650 nm enables the input video signal to be attenuated, and the signals other than the video signal to be transmitted.

Alternatively, multiple notches 73 as shown in Figs. 6(a) and 6(b), which are formed in the cladding of an optical fiber consisting of a core 71 and a cladding 72 covering the external surface of the core 71, makes it possible to reflect a particular wavelength signal of an input signal, thereby rejecting it. In addition, a dielectric multilayer 76 as shown in Fig. 6(c), which is disposed at an end surface of the optical fiber 75, can reflect the wavelength equal to or greater than 1650 nm, thereby rejecting it. Thus, the optical fibers as shown in Figs. 6(a)-6(c) can also be used as the wavelength division multiplexer/demultiplexer (WDM) of the subscriber unit.

Next, the operation will be described.

In the central office unit 1, the video signal generator 11 supplies its video signal to the transmitting laser diode

(LD) 12. The transmitting laser diode (LD) 12 supplies it to the wavelength division multiplexer/demultiplexer (WDM) 13 in the form of the optical signal. The wavelength division multiplexer/demultiplexer (WDM) 13 multiplexes the optical signal with the optical signal from the transmitting and receiving section 14, and supplies it to the star coupler 2 via the optical fiber 3. The star coupler 2 splits the signal and supplies them to the subscriber units 5a, 5b and so on.

In the subscriber unit 5a, the wavelength division multiplexer/demultiplexer (WDM) 31a demultiplexes the input signal into the video signal and the other signals, and supplies the video signal to the video receiver 33a via the receiving photodiode (PD) 32a. On the other hand, the signals other than the video signal are supplied to the receiving photodiode (PD) 42a via the wavelength division multiplexer/demultiplexer (WDM) 41a in the transmitting and receiving section 34a, to be converted into the electric signal. Then, the electric signal multiplexer/demultiplexer 44a demultiplexes the electric signal into respective signals so that the telephone signal is supplied to the telephone set 47a via the A/D converter 45a, and the facsimile signal is supplied to the facsimile machine 48a via the A/D converter 46a. As for the computer signal, the electric signal multiplexer/demultiplexer 44a supplies it directly to the personal computer 49a.

On the other hand, as for the signals supplied from the devices connected to the subscriber unit 5a such as the signal from the telephone set 47a, for example, the A/D converter 45a converts it to the digital signal, and supplies it to the transmitting laser diode (LD) 43a via the electric signal multiplexer/demultiplexer 44a. The transmitting laser diode

(LD) 43a converts it to the optical signal, and supplies it to the star coupler 2 via the wavelength division multiplexer/demultiplexers (WDMs) 41a and 31a and the optical fiber 4a. The star coupler 2 sends it to the central office unit 1 via the optical fiber 3, where it is supplied to the receiving photodiode (PD) 23 via the wavelength division multiplexer/demultiplexers (WDMs) 13 and 21, to be converted into the electric signal and output. The output signal passes through the signal processor 24 and the electric signal multiplexer/demultiplexer 15, and is supplied to the processing section 16, where it passes through the signal processor 17, and is converted to the optical signal by the transmitting laser diode (LD) 18, again, to be transmitted to another station.

On the other hand, the subscriber unit 5b, which requires no video service, does not comprise the corresponding wavelength division multiplexer/demultiplexer (WDM). Thus, the signal that is split by the star coupler 2 and includes the video signal is directly input to the wavelength division multiplexer/demultiplexer 41b. The wavelength division multiplexer/demultiplexer 41b, however, rejects the wavelength of the video signal by absorbing or reflecting it. Therefore, only the signals other than the video signal are transmitted to the receiving photodiode (PD) 42b.

As described above, the present embodiment 1 is configured such that the subscriber unit of a subscriber who does not want to receive the video service utilizes the wavelength division multiplexer/demultiplexer (WDM) that absorbs the wavelength region of the video signal (Fig. 4), or the wavelength division multiplexer/demultiplexer (WDM) that reflects the wavelength region of the video signal (Fig. 6). Thus, the subscriber unit

can reject the video signal even if the video signal and the other signals sent from the central office unit 1 are input together. Accordingly, it obviates the expensive spatial optical filter which is conventionally required for separating the video signal and the other signals. As a result, a low cost subscriber unit is implemented, which enables a subscriber who does not receive the video service to use the inexpensive subscriber unit.

Besides, the present embodiment 1 can utilize any of the wavelength division multiplexer/demultiplexers (WDMs) as shown in Fig. 6 that reflect the wavelength region of the video signal as the second wavelength division multiplexer/demultiplexer (WDM) 41a among the first and second wavelength division multiplexer/demultiplexers (WDMs) 31a and 41a of the subscriber unit 5a. Thus, the second wavelength division multiplexer/demultiplexer (WDM) 41a can remove the video signal the first wavelength division multiplexer/demultiplexer (WDM) 31a cannot fully eliminate. Therefore, a comparatively low separation accuracy, inexpensive WDM can be used as the first wavelength division multiplexer/demultiplexer (WDM) 31a.

EMBODIMENT 2

Fig. 7 is a block diagram showing a configuration of an embodiment 2 of the data transmission system in accordance with the present invention. In the present embodiment 2, the central office unit 1 multiplexes the video signal onto the outputs of the plurality of transmitting and receiving sections 14a and 14b. In this case, when the output of the transmitting laser diode 12a is split directly to n parts by the star coupler 82 serving as the optical distributor, the output level of the star

coupler 82 will reduce by a factor of n. Thus, the output of the transmitting laser diode 12a is amplified by an optical amplifier 81 before split by the star coupler 82. Since the remaining configuration is the same as that of the foregoing embodiment 1, the description thereof is omitted here. Besides, Fig. 7 shows those components of the embodiment 1 that transmit only the optical signals.

Next, the operation will be described.

In the central office unit 1, the video signal generator 11a supplies its output signal to the transmitting laser diode (LD) 12a. The transmitting laser diode (LD) 12a outputs a signal in the 1650-1660 nm wavelength region, which is amplified by the optical amplifier 81. The star coupler (SC) 82 splits the signal, and supplies the split signals to the wavelength division multiplexer/demultiplexer (WDM) 13a (13b). It multiplexes the signal with the output of the wavelength division multiplexer/demultiplexer (WDM) 21a (21b) of the transmitting and receiving section 14a (14b), which is obtained by multiplexing the signals from the telephone, facsimile machine and personal computer, for example.

Subsequently, the output of the wavelength division multiplexer/demultiplexer 13a (13b) is transmitted to the star coupler (SC) 2a (-2n) via the optical fiber 3a (3b). The star coupler (SC) 2a (2b) splits it and supplies to the subscriber unit 5a (the subscriber units for the star coupler 2b are not shown). Then, the subscriber unit 5a, which comprises the video receiver 33a, separates the video signal from the remaining signal using the wavelength division multiplexer/demultiplexer 31a. The video signal is supplied to the receiving photodiode (PD) 32a that converts it into the electric signal and supplies

it to the video receiver 33a.

On the other hand, the subscriber unit 5b requiring no video service does not include the corresponding wavelength division multiplexer/demultiplexer (WDM). Thus, the signal that is split by the star coupler 2a and includes the video signal is directly input to the wavelength division multiplexer/demultiplexer 41b. The wavelength division multiplexer/demultiplexer 41b, however, rejects the wavelength of the video signal by absorbing or reflecting it. Therefore, only the signals other than the video signal are transmitted to the receiving photodiode (PD) 42b.

As described above, the present embodiment 2 is configured such that it shares the video signal source, the output of which is multiplexed with the outputs of the multiple transmitting and receiving sections 14a and 14b in the central office unit 1. Accordingly, the present embodiment can reduce the total cost of the data transmission system.

EMBODIMENT 3

Fig. 8 is a block diagram showing a configuration of an embodiment 3 of the data transmission system in accordance with the present invention. In the present embodiment 3, the central office unit 1 comprises multiple video signal generators 11a and 11b, the outputs of which are multiplexed by a first wavelength division multiplexer/demultiplexer (WDM) 83. Its output is amplified by the optical amplifier 81, split by the star coupler 82, and then multiplexed by the second wavelength division multiplexer/demultiplexer (WDM) 13a. Since the remaining configuration and the operation is the same as that of the foregoing embodiment 2, the description thereof is omitted

here. Besides, Fig. 8 shows those components of the embodiment 1 that transmit only the optical signals.

As described above, the embodiment 3 is configured such that the first wavelength division multiplexer/demultiplexer (WDM) 83 multiplexes the multiple video signals. Therefore, the present embodiment 3 can easily cope with the growing capacity in the future.

Although the foregoing embodiments are described taking an example of the ATM-PDS (asynchronous transfer mode passive double star) system, in which the star coupler (SC) 2a (2b...) splits the signal supplied from the central office unit 1 via the optical fiber 3a (3b...), and its split output terminals are connected to the subscriber units via the optical fibers 4a, 4b..., such a configuration is not essential. For example, an ATM-PDS (asynchronous transfer mode passive double star) system is also possible which does not use any star coupler (SC) 2a (2b...) as the optical distributor, and which comprises multiple central office units 1 having one-to-one correspondence with the subscriber units 5a and 5b connected thereto. In this case, the ATM-PDS system is configured such that the central office unit 1 multiplexes the multiple signals, and transmits them to the subscriber unit 5a, and that the subscriber unit 5a employs the wavelength division multiplexer/demultiplexer (WDM) that reflects of absorbs the wavelength region of a particular signal when it does not receive the particular signal. Thus, it can provides a subscriber with the inexpensive subscriber unit.

INDUSTRIAL APPLICABILITY

As described above, the data transmission system according to the present invention enables the central office unit to

deliver the video signal to the individual subscriber units, and enables the subscriber units to receive the video signal. Thus, it can provide subscribers who do not want to receive the video services with the inexpensive subscriber unit.

WHAT IS CLAIMED IS:

1. A data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, said data transmission system comprising in said subscriber unit:

a wavelength division multiplexer/demultiplexer having a function of eliminating a particular wavelength signal.

2. The data transmission system according to claim 1, wherein said wavelength division multiplexer/demultiplexer reflects the particular wavelength signal to reject its input.

3. The data transmission system according to claim 1, wherein said wavelength division multiplexer/demultiplexer comprises a reflecting layer for reflecting the particular wavelength signal at an input end surface of an optical fiber of the subscriber unit.

4. The data transmission system according to claim 3, wherein said reflecting layer consists of a dielectric multilayer filter.

5. The data transmission system according to claim 1, comprising an optical fiber with a core and a cladding that covers an external surface of the core, and that has multiple notches formed on the cladding to reflect the particular wavelength signal.

6. The data transmission system according to claim 1, wherein said wavelength division multiplexer/demultiplexer comprises an optical waveguide that is made of a polymer and absorbs a signal with a wavelength of 1650 nm, which is employed as the particular wavelength signal.

7. A data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, said central office unit comprising:

an optical amplifier for amplifying the video signal to be transmitted; and

an optical distributor for distributing the video signal output from said optical amplifier, and supplying it to a wavelength division multiplexer/demultiplexer, wherein

each of said subscriber units comprises a wavelength division multiplexer/demultiplexer having a function of eliminating a particular wavelength signal.

8. A data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, said central office unit comprising:

a plurality of video signal generators for generating video signals with different wavelengths;

a first wavelength division multiplexer/demultiplexer for multiplexing the video signals supplied from said plurality of video signal generators;

an optical amplifier for amplifying the video signals output from said first wavelength division multiplexer/demultiplexer; and

an optical distributor for distributing the video signals output from said optical amplifier to a second wavelength division multiplexer/demultiplexer, wherein

each of said subscriber units comprises a wavelength division multiplexer/demultiplexer with a function of eliminating a particular wavelength signal.

9. A data transmission system including subscriber units and a central office unit which are interconnected via optical fibers, the central office unit multiplexing a video signal with signals other than the video signal to deliver them to the multiple subscriber units, and each subscriber unit demultiplexing a received signal, said subscriber unit comprising:

a first wavelength division multiplexer/demultiplexer for demultiplexing the video signals and signals other than the video signal; and

a second wavelength division multiplexer/demultiplexer with a function of eliminating a particular wavelength signal.

ABSTRACT OF THE DISCLOSURE

A data transmission system includes subscriber units and a central office unit which are interconnected via optical fibers. The central office unit multiplexes a video signal with signals other than the video signal to deliver them to the multiple subscriber units. Each subscriber unit demultiplexes a received signal, and includes a wavelength division multiplexer/demultiplexer having a function of eliminating a particular wavelength signal in the subscriber unit.

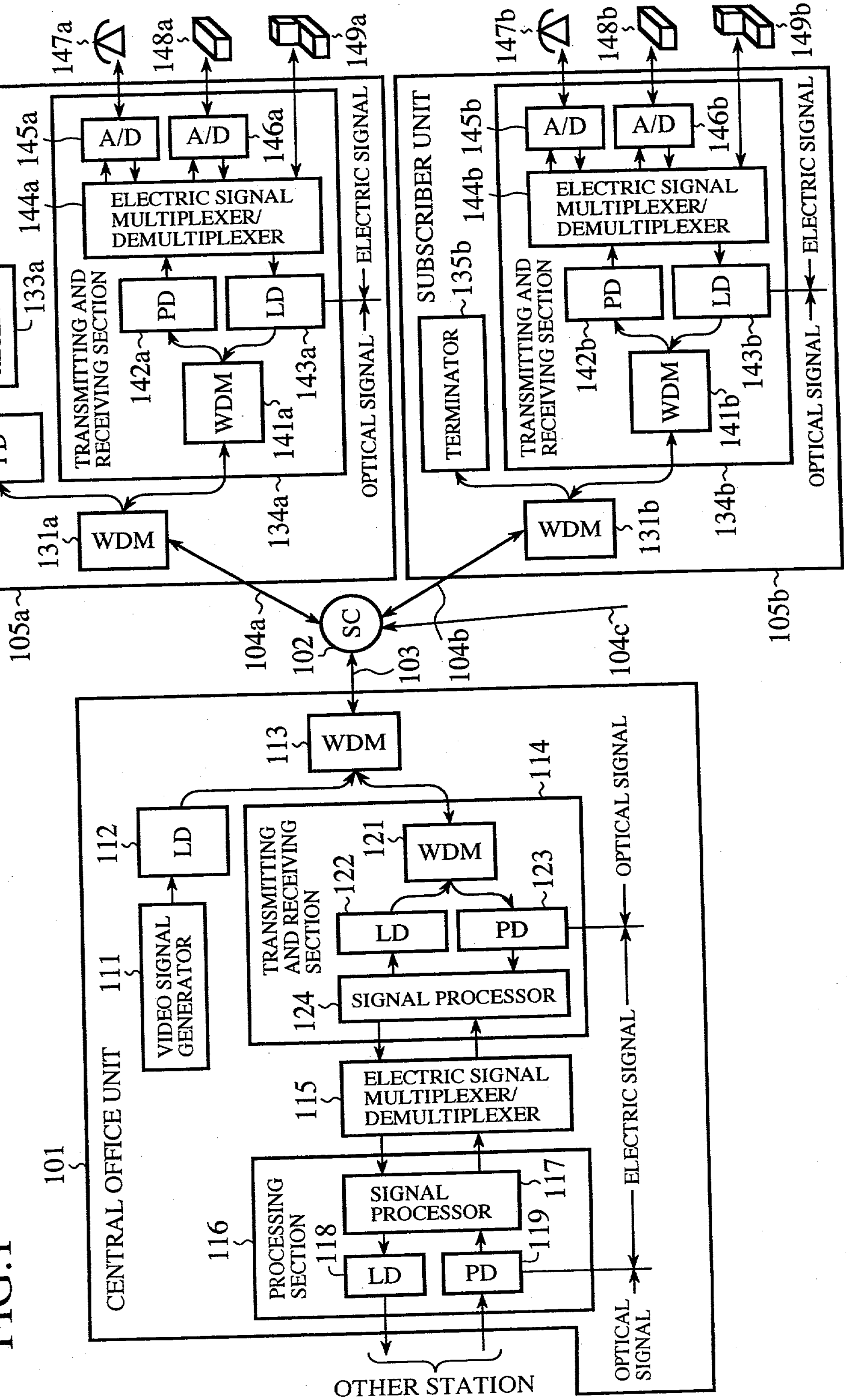
SUBSCRIBER UNIT
VIDEO RECEIVER
PD
WDM
TRANSMITTING AND RECEIVING SECTION
A/D
A/D
ELECTRIC SIGNAL MULTIPLEXER/ DEMULTIPLEXER
PD
LD
WDM
ELECTRIC SIGNAL
OPTICAL SIGNAL
147a
148a
149a
145a
144a
146a
133a
132a
131a
142a
143a
141a
134a
105a
SUBSCRIBER UNIT
TERMINATOR
TRANSMITTING AND RECEIVING SECTION
A/D
A/D
ELECTRIC SIGNAL MULTIPLEXER/ DEMULTIPLEXER
PD
LD
WDM
WDM
ELECTRIC SIGNAL
OPTICAL SIGNAL
147b
148b
149b
145b
144b
146b
135b
142b
143b
141b
134b
131b
105b
SC
102
103
104a
104b
104c
CENTRAL OFFICE UNIT
101
WDM
113
LD
112
VIDEO SIGNAL GENERATOR
111
TRANSMITTING AND RECEIVING SECTION
114
WDM
121
LD
122
PD
123
SIGNAL PROCESSOR
124
ELECTRIC SIGNAL MULTIPLEXER/ DEMULTIPLEXER
115
PROCESSING SECTION
116
SIGNAL PROCESSOR
117
LD
118
PD
119
OPTICAL SIGNAL
ELECTRIC SIGNAL
OPTICAL SIGNAL
OTHER STATION

FIG.1

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FIG.2

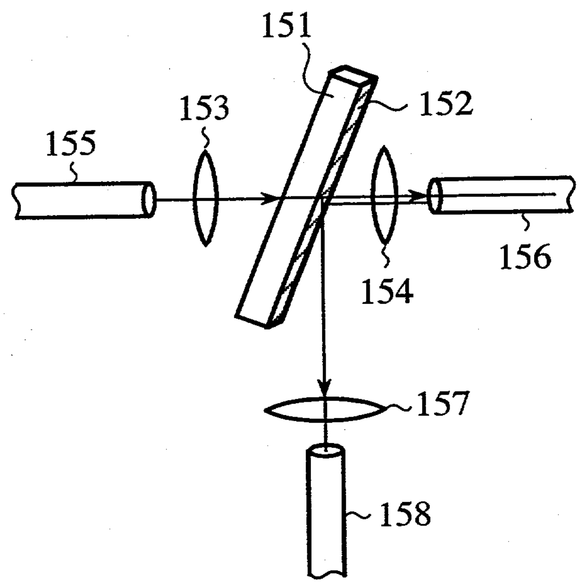


FIG.4

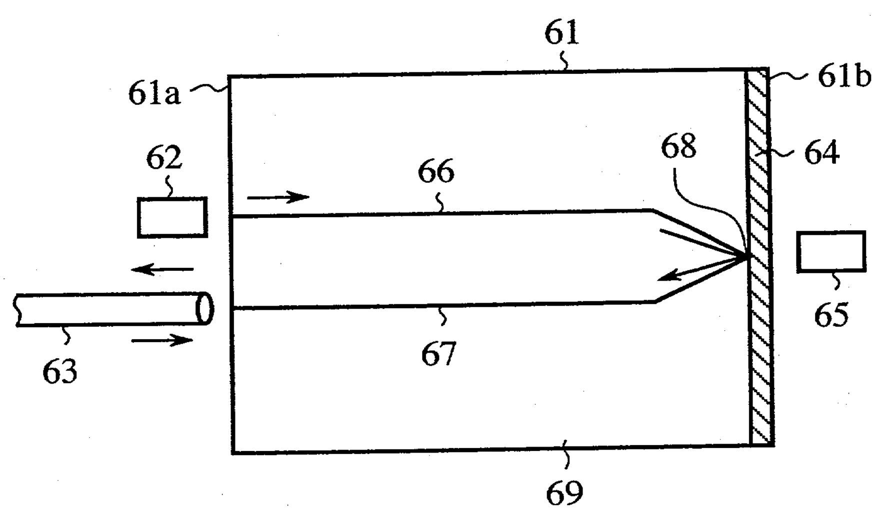


FIG.3

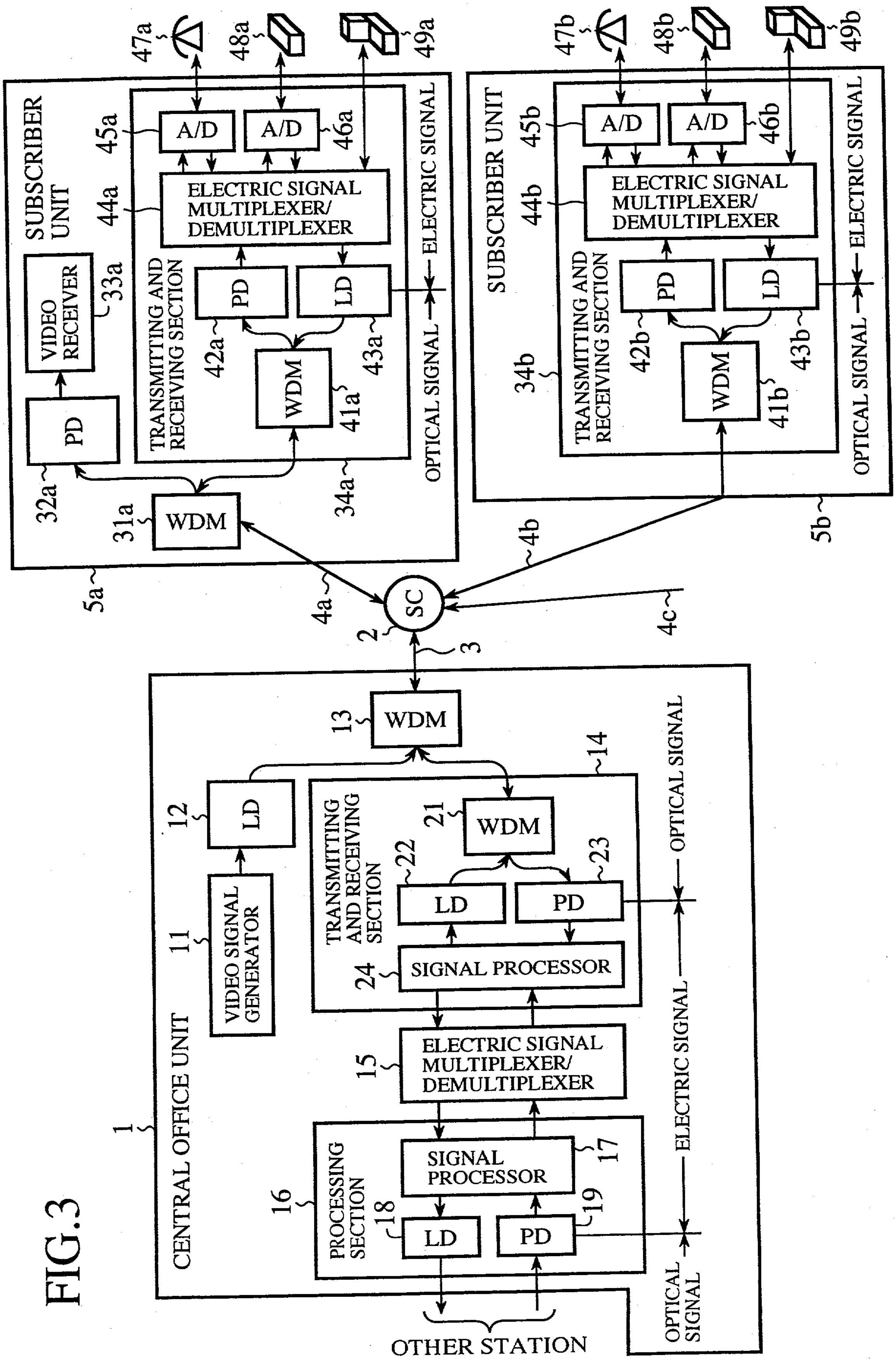

SUBSCRIBER UNIT
VIDEO RECEIVER
PD
WDM
TRANSMITTING AND RECEIVING SECTION
A/D
A/D
ELECTRIC SIGNAL MULTIPLEXER/ DEMULTIPLEXER
PD
LD
WDM
ELECTRIC SIGNAL
OPTICAL SIGNAL
47a
48a
49a
45a
46a
44a
33a
32a
31a
42a
43a
41a
34a
5a
SUBSCRIBER UNIT
TRANSMITTING AND RECEIVING SECTION
47b
48b
49b
45b
46b
44b
34b
42b
43b
41b
5b
4a
4b
4c
SC
2
3
CENTRAL OFFICE UNIT
WDM
13
LD
12
VIDEO SIGNAL GENERATOR
11
TRANSMITTING AND RECEIVING SECTION
14
WDM
21
LD
22
PD
23
SIGNAL PROCESSOR
24
ELECTRIC SIGNAL MULTIPLEXER/ DEMULTIPLEXER
15
PROCESSING SECTION
16
SIGNAL PROCESSOR
17
LD
18
PD
19
1
OTHER STATION

FIG.5

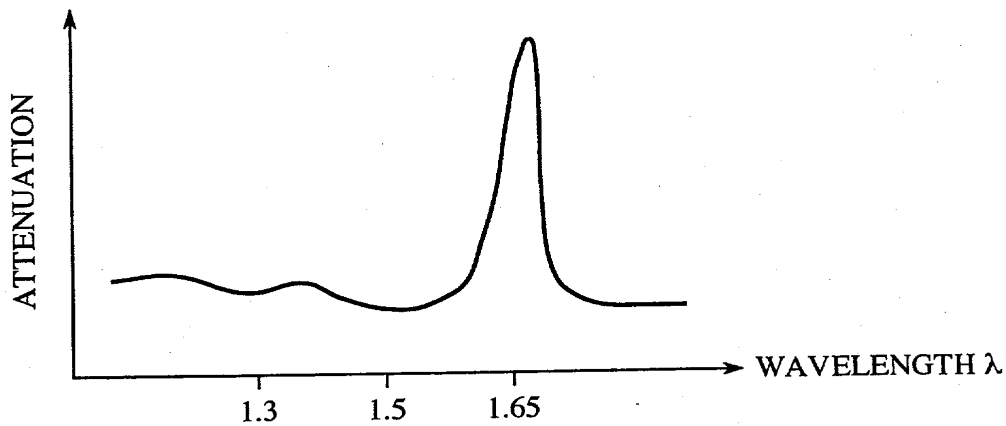
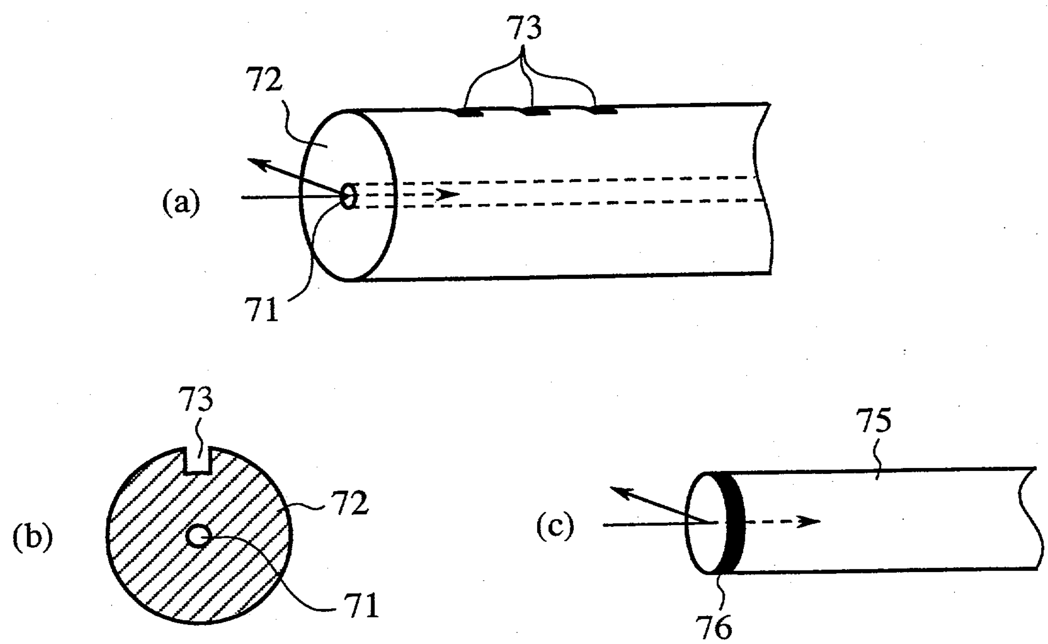
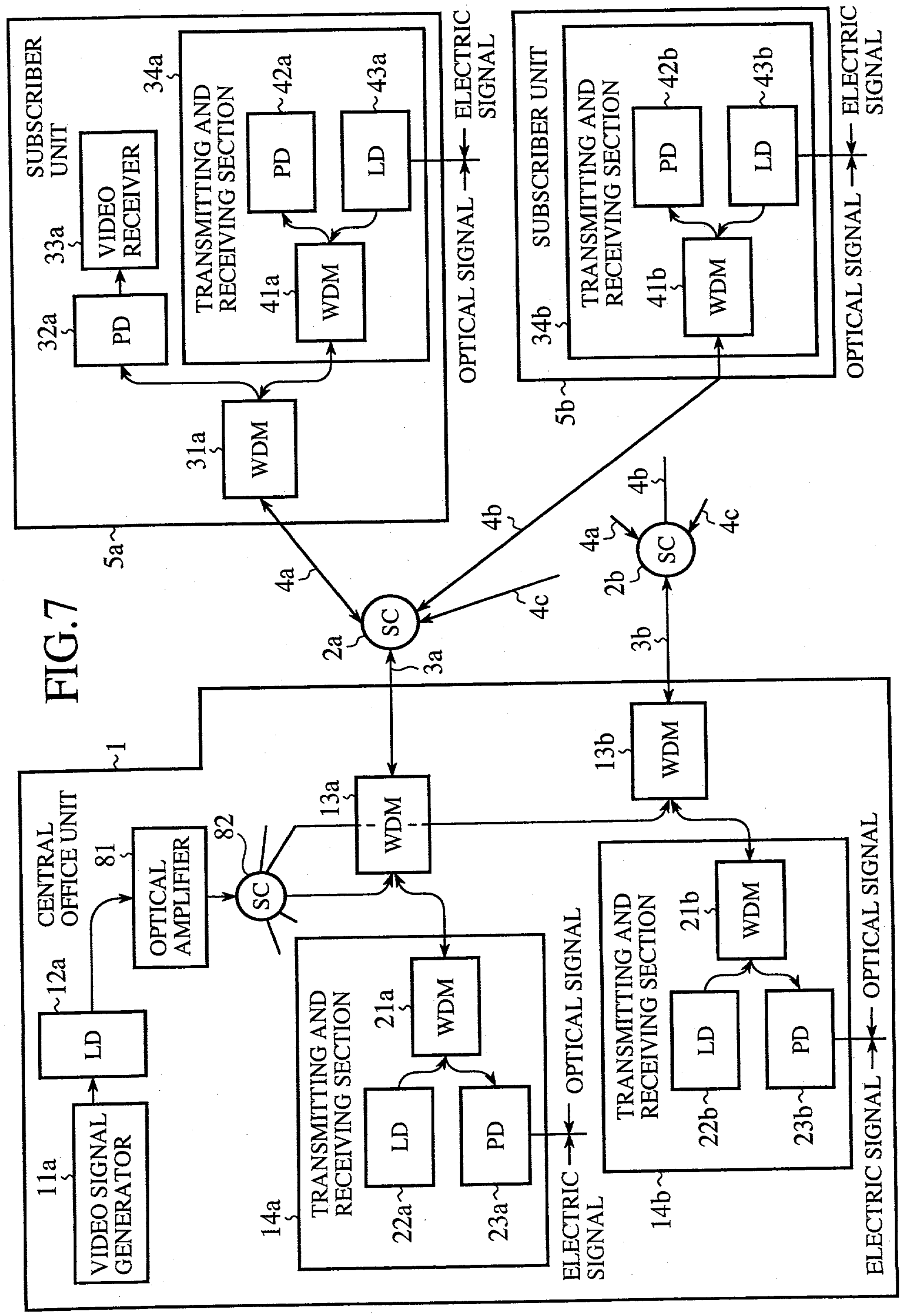


FIG.6

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VIDEO RECEIVER
33a
32a
PD
34a
TRANSMITTING AND RECEIVING SECTION
PD
42a
LD
43a
41a
WDM
31a
WDM
ELECTRIC SIGNAL
OPTICAL SIGNAL
5a
SUBSCRIBER UNIT
34b
TRANSMITTING AND RECEIVING SECTION
PD
42b
LD
43b
41b
WDM
ELECTRIC SIGNAL
OPTICAL SIGNAL
5b
4a
4b
4c
SC
2a
3a
4b
4a
4c
SC
2b
3b
1
CENTRAL OFFICE UNIT
VIDEO SIGNAL GENERATOR
11a
LD
12a
OPTICAL AMPLIFIER
81
SC
82
WDM
13a
WDM
13b
TRANSMITTING AND RECEIVING SECTION
14a
WDM
21a
LD
22a
PD
23a
OPTICAL SIGNAL
ELECTRIC SIGNAL
TRANSMITTING AND RECEIVING SECTION
14b
WDM
21b
LD
22b
PD
23b
OPTICAL SIGNAL
ELECTRIC SIGNAL

FIG.7

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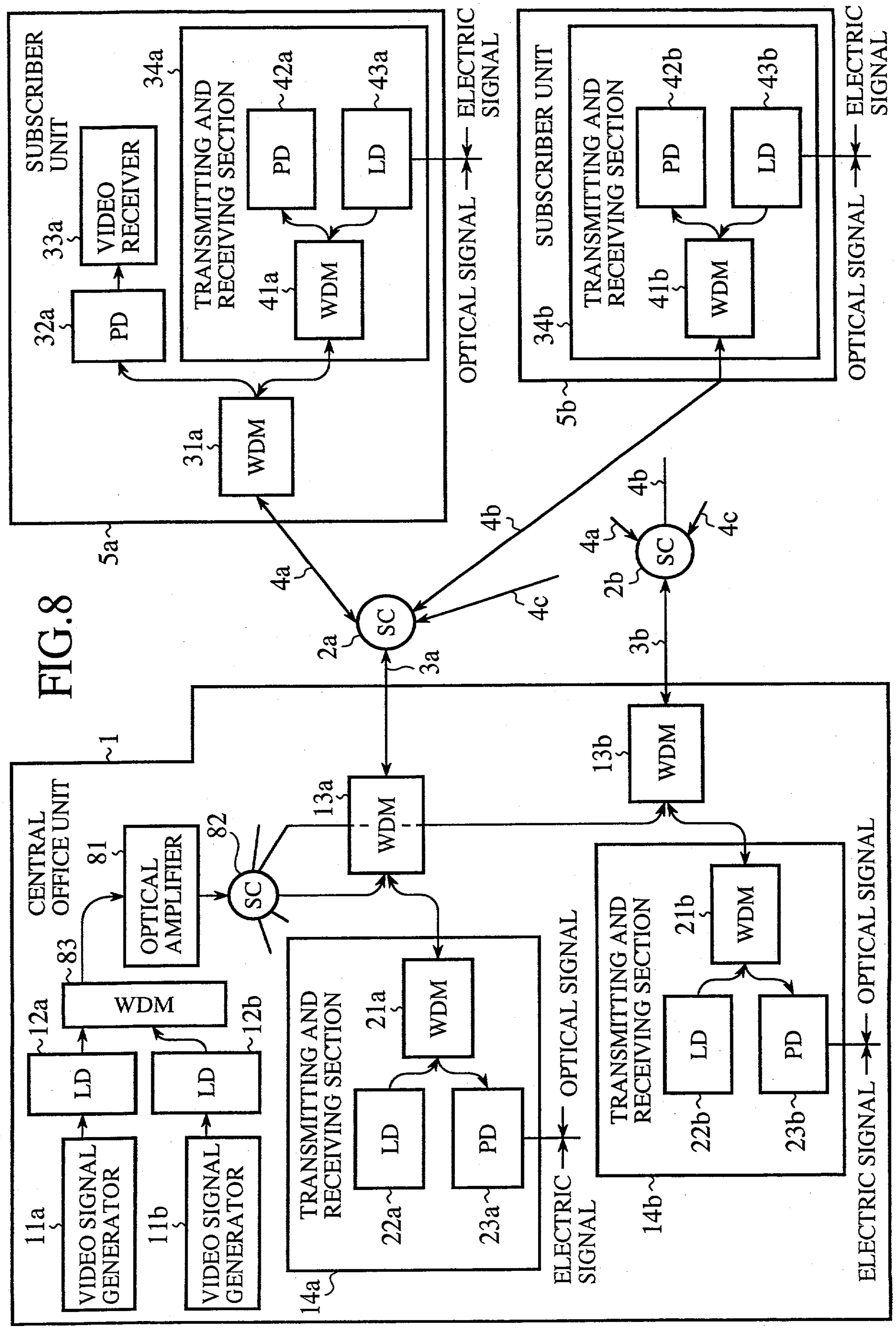

FIG.8

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

"DATA TRANSMISSION SYSTEM"

上記発明の明細書は、

☐ 本書に添付されています。

☐ ___月___日に提出され、米国出願番号または特許協定条約国際出願番号を__________とし、（該当する場合）__________に訂正されました。

the specification of which

☐ is attached hereto.

☒ was filed on October 6, 2000 as United States Application Number or PCT International Application Number PCT/JP00/07000 and was amended on __________ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条（a）－（d）項又は365条（b）項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365（a）項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張	
PCT/JP00/04065	PCT	21/June/2000	☒ Yes はい	☐ No いいえ
			☐ Yes はい	☐ No いいえ

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
（日本語宣言書）

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
（弁護士、または代理人の指名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

022850

書類送付先

Send Correspondence to:

022850

直接電話連絡先：（名前及び電話番号）

Direct Telephone Calls to: (name and telephone number)
(703) 413-3000

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発明者の署名　日付	Inventor's signature　Date Masatoshi Katayama　January 16, 2002
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国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o MITSUBISHI DENKI KABUSHIKI KAISHA,
	2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-8310 Japan
第二の共同発明者の氏名	Full name of second joint inventor, if any
第二の共同発明者の署名　日付	Second joint Inventor's signature　Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第三以降の共同発明者についても同様に記載し、署名すること）

(Supply similar information and signature for third and subsequent joint inventors.)

1/01